

Simulation Project Analysis

CSCI-4210

Operating Systems

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1 Best Algorithm for CPU-bound vs I/O-bound Processes

The team collected data for runs consisting of mainly I/O-bound processes which are shown in Tables 1 through 5, and data for runs consisting of mainly CPU-bound processes which are shown in Tables 6 through 10. It can be observed that preemptive algorithms have lower average turnaround times and waiting times than their non-preemptive counterparts. This is predicted to be the case due to some processes occasionally having high CPU burst times which would become a bottle neck for the rest of the I/O bound processes. *RR* was not as fast as *SRT*. The team attributes this behavior to the increased number of preemptions that *RR* causes (As seen in Table 1 and Table 2) which have a context switch latency. Therefore, the team found that *SRT* was the best suited algorithm for I/O bound processes.

It was found that preemptive algorithms were also better than their non-preemptive counterparts for CPU-bound processes as well. Table 7 through Table 9 show *RR* outperforming *SRT* but in Table 10, *SRT* outperforms *RR* because the context switch latency is high but the time slice isn't as high. More preemptions in the middle of process execution leads to higher average turn around times for *RR*. Therefore, the team found that *RR* was the best suited algorithm, over all, for CPU bound processes.

2 RR Algorithm With rr_{add} set to BEGINNING vs END

Tables 4,5,9 and 10 are runs that have the optional flag rr_{add} :BEGINNING

3 Comparison Between SJF and SRT

4 Limitations of Our Simulation

5 Priority Scheduling Algorithm of Our Own Design

6 Appendix

Program Arguments

[executable] [n] [seed] [λ] [limit] [t_{cs}] [α] [t_{slice}] [rr_{add} : BEGINNING or END, default: END]

Program Execution Data

Table 1: I/O bound [n:1] [seed:2] [λ :0.01] [limit:256] [t_{cs} :4] [α :0.5] [t_{slice} :128]

Algorithm	Average CPU Burst Time (ms)	Average Wait Time (ms)	Average Turnaround Time (ms)	Total Number of Context Switches	Total Number of Preemptions	CPU Utilization (%)
<i>FCFS</i>	286.957	82.3043	373.261	23	0	39.3185
<i>SJF</i>	286.957	87.5217	378.478	23	0	38.5514
<i>SRT</i>	286.957	87.5217	378.478	23	0	38.5514
<i>RR</i>	286.957	95.6522	388.87	36	13	38.1856

Table 2: I/O bound [n:16] [seed:2] [λ :0.01] [limit:256] [t_{cs} :4] [α :0.75] [t_{slice} :64]

Algorithm	Average CPU Burst Time (ms)	Average Wait Time (ms)	Average Turnaround Time (ms)	Total Number of Context Switches	Total Number of Preemptions	CPU Utilization (%)
<i>FCFS</i>	286.957	82.3043	373.261	23	0	39.3185
<i>SJF</i>	286.957	87.5217	378.478	23	0	38.5514
<i>SRT</i>	286.957	87.5217	378.478	23	0	38.5514
<i>RR</i>	286.957	93.6957	389.174	49	26	38.1062

Table 3: I/O bound [n:8] [seed:64] [λ :0.001] [limit:4096] [t_{cs} :4] [α :0.5] [t_{slice} :2048]

Algorithm	Average CPU Burst Time (ms)	Average Wait Time (ms)	Average Turnaround Time (ms)	Total Number of Context Switches	Total Number of Preemptions	CPU Utilization (%)
<i>FCFS</i>	286.957	82.3043	373.261	23	0	39.3185
<i>SJF</i>	286.957	87.5217	378.478	23	0	38.5514
<i>SRT</i>	286.957	113.522	405.174	27	4	38.5424
<i>RR</i>	286.957	82.3043	373.261	23	0	39.3185

Table 4: I/O bound $[n:8]$ [seed:64] $[\lambda:0.001]$ [limit:4096] $[t_{cs}:4]$ $[\alpha:0.5]$ $[t_{slice}:2048]$ $[rr_{add}:\text{BEGINNING}]$

Algorithm	Average CPU Burst Time (ms)	Average Wait Time (ms)	Average Turnaround Time (ms)	Total Number of Context Switches	Total Number of Preemptions	CPU Utilization (%)
<i>FCFS</i>	286.957	82.3043	373.261	23	0	39.3185
<i>SJF</i>	286.957	87.5217	378.478	23	0	38.5514
<i>SRT</i>	286.957	113.522	405.174	27	4	38.5424
<i>RR</i>	286.957	156.217	447.174	23	0	38.6281

Table 5: I/O bound $[n:8]$ [seed:64] $[\lambda:0.001]$ [limit:4096] $[t_{cs}:20]$ $[\alpha:0.5]$ $[t_{slice}:2048]$ $[rr_{add}:\text{BEGINNING}]$

Algorithm	Average CPU Burst Time (ms)	Average Wait Time (ms)	Average Turnaround Time (ms)	Total Number of Context Switches	Total Number of Preemptions	CPU Utilization (%)
<i>FCFS</i>	286.957	88.4783	395.435	23	0	38.9841
<i>SJF</i>	286.957	95.8696	402.826	23	0	38.1944
<i>SRT</i>	286.957	106.522	416.087	26	3	38.1503
<i>RR</i>	286.957	163.87	470.826	23	0	38.3053

Table 6: CPU bound $[n:1]$ [seed:2] $[\lambda:0.01]$ [limit:256] $[t_{cs}:4]$ $[\alpha:0.5]$ $[t_{slice}:128]$

Algorithm	Average CPU Burst Time (ms)	Average Wait Time (ms)	Average Turnaround Time (ms)	Total Number of Context Switches	Total Number of Preemptions	CPU Utilization (%)
<i>FCFS</i>	1629.22	3216.87	4850.09	23	0	98.0326
<i>SJF</i>	1629.22	2596.35	4229.57	23	0	94.7603
<i>SRT</i>	1629.22	2543.57	4178.17	31	8	94.6836
<i>RR</i>	1629.22	2249.39	3913.57	201	178	92.0236

Table 7: CPU bound $[n:16]$ [seed:2] $[\lambda:0.01]$ [limit:256] $[t_{cs}:4]$ $[\alpha:0.75]$ $[t_{slice}:64]$

Algorithm	Average CPU Burst Time (ms)	Average Wait Time (ms)	Average Turnaround Time (ms)	Total Number of Context Switches	Total Number of Preemptions	CPU Utilization (%)
<i>FCFS</i>	1629.22	3216.87	4850.09	23	0	98.0326
<i>SJF</i>	1629.22	2596.35	4229.57	23	0	94.7603
<i>SRT</i>	1629.22	2543.57	4178.17	31	8	94.6836
<i>RR</i>	1629.22	2327.13	4024.17	390	367	90.0683

Table 8: CPU bound $[n:8]$ [seed:64] $[\lambda:0.001]$ [limit:4096] $[t_{cs}:4]$ $[\alpha:0.5]$ $[t_{slice}:2048]$

Algorithm	Average CPU Burst Time (ms)	Average Wait Time (ms)	Average Turnaround Time (ms)	Total Number of Context Switches	Total Number of Preemptions	CPU Utilization (%)
<i>FCFS</i>	1629.22	3216.87	4850.09	23	0	98.0326
<i>SJF</i>	1629.22	2730.65	4363.87	23	0	95.3146
<i>SRT</i>	1629.22	2017.39	3652.35	33	10	94.6645
<i>RR</i>	1629.22	2829.35	4463.78	30	7	95.2468

Table 9: CPU bound $[n:8]$ $[seed:64]$ $[\lambda:0.001]$ $[limit:4096]$ $[t_{cs}:4]$ $[\alpha:0.5]$ $[t_{slice}:2048]$ $[rr_{add}:BEGINNING]$

Algorithm	Average CPU Burst Time (ms)	Average Wait Time (ms)	Average Turnaround Time (ms)	Total Number of Context Switches	Total Number of Preemptions	CPU Utilization (%)
<i>FCFS</i>	1629.22	3216.87	4850.09	23	0	98.0326
<i>SJF</i>	1629.22	2730.65	4363.87	23	0	95.3146
<i>SRT</i>	1629.22	2017.39	3652.35	33	10	94.6645
<i>RR</i>	1629.22	1743.61	3378.04	30	7	95.6162

Table 10: CPU bound $[n:8]$ $[seed:64]$ $[\lambda:0.001]$ $[limit:4096]$ $[t_{cs}:20]$ $[\alpha:0.5]$ $[t_{slice}:2048]$ $[rr_{add}:BEGINNING]$

Algorithm	Average CPU Burst Time (ms)	Average Wait Time (ms)	Average Turnaround Time (ms)	Total Number of Context Switches	Total Number of Preemptions	CPU Utilization (%)
<i>FCFS</i>	1629.22	3255.13	4904.35	23	0	97.0978
<i>SJF</i>	1629.22	2761.26	4410.48	23	0	94.4307
<i>SRT</i>	1629.22	2057.74	3715.65	33	10	93.4184
<i>RR</i>	1629.22	2876.65	4531.96	30	7	94.0987